

THE NATIVE CALIFORNIAN SPECIES OF THE  
GENUS COREOPSIS L.

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For the past three years the writer has been engaged in a floristic survey of the Mount Hamilton Range, a northern unit of the inner South Coast Ranges of California. The interior and eastern regions of the Mount Hamilton Range are comparatively isolated, and in the past they have received little botanical exploration. Recent field work has resulted, therefore, in the accumulation of information on several new or little known species of Californian plants. This paper is an outgrowth of field acquaintance with the four species of *Coreopsis* which grow in the Mount Hamilton Range.

From the time of De Candolle to recent years, the Californian species of *Coreopsis* have had a varied generic history involving *Leptosyne* DC., *Agarista* DC., *Tuckermannia* Nutt., and *Pugiopappus* Gray. In the Synoptical Flora of North America (1<sup>2</sup>: 299-301. 1884), Gray included these four genera, along with *Coreocarpus* Benth. and *Acoma* Benth., in an amplified version of *Leptosyne*, limiting the genus *Coreopsis* to the eastern side of the continent. This was the accepted interpretation of many subsequent botanists. Harvey M. Hall (Univ. Calif. Publ. Bot. 3: 139-143. 1907) followed Bentham and Hooker (Genera Plantarum 2: 385. 1873) and O. Hoffmann (in Engler and Prantl, Natürlichen Pflanzenfamilien 4<sup>5</sup>: 243. 1894) in uniting *Leptosyne* with *Coreopsis*. In "A redistribution of the species heretofore referred to *Leptosyne*" (Proc. Am. Acad. 49: 335-346. 1913), S. F. Blake amply substantiated this viewpoint, but removed *Coreocarpus*, a Sonoran genus of three species, from the aggregate genus *Coreopsis*. His paper gives a complete presentation of the generic and intrageneric relationships involved. According to his conception the native Californian species of the genus *Coreopsis* belong to the subgenus *Leptosyne* (DC.) Blake. This subgenus also embraces six Mexican species and reaches south as far as Guatemala.

The eight Californian species of *Coreopsis*, including six annuals and two perennials, are almost entirely restricted to the botanical province of California. They are most abundant in the cismontane and desert areas of southern California, and only *C. Stillmanii* reaches north of central California. Two of the eight species, *C. maritima* and *C. californica*, transgress the political boundaries of the state, but neither is found any considerable distance beyond. The accompanying map (text fig. 1) represents the distribution of the genus in California.

Field observations have indicated that fresh material is necessary for adequate taxonomic treatment of the annual species



Fig. 1. Distribution of native Californian species of *Coreopsis*.

of *Coreopsis* found in California. Many of the distinguishing characters, particularly those of the leaves and of the involucre, are lost in the pressed specimens. All six annual species were studied from fresh material, either from that gathered in the field or from garden cultures. In addition heads preserved in formalin were obtained for two of the southern Californian species.

In addition to field observations and study of fresh material, herbarium specimens were borrowed from the following Californian institutions, and appreciation is expressed to the curators of these herbaria: California Academy of Sciences, San Francisco (CA), Dudley Herbarium, Stanford University (SU), Pomona College, Claremont (P), Santa Barbara Museum of

Natural History (SBM), University of California (UC), University of California at Los Angeles (UCLA), Vegetation Type Map Herbarium, California Forest and Range Experiment Station, Berkeley (VTM).

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#### KEY TO THE NATIVE CALIFORNIAN SPECIES OF COREOPSIS

Annuals; stems slender, 5-60 cm. tall; cismontane and desert species.

Achenes dimorphic; disc achenes ciliate, pappus paleae 2, ray achenes glabrous, epappose. Section *Pugiopappus* (Gray) Blake.

Outer series of involucre bracts linear, obtuse, shorter to longer than the ovate inner series; leaves mostly basal and scapes naked.

Ligules horizontal in anthesis; receptacular bracts falling attached to disc achenes; palea of disc achenes mostly 2 mm. long.

1. *C. Bigelovii*.

Ligules strongly reflexed in anthesis; receptacular bracts falling separately from disc achenes; palea of disc achenes 1 mm. long.

2. *C. hamiltonii*.

Outer series of involucre bracts broadly ovate, acute, shorter than the oblong-ovate inner series; lower  $\frac{1}{3}$  to  $\frac{1}{2}$  of stems leafy, leaves only slightly clustered at base; palea of disc achenes mostly 4 mm. long

3. *C. calliopsidea*.

Achenes monomorphic, non-ciliate; pappus reduced to a cupule. Section *Euleptosyne* (Gray) Blake.

Leaves linear to filiform, fleshy, 1 mm. wide, entire or with 1-2 linear pinnae, terminal lobe not broader; annulus of disc corollas bearded; outer involucre bracts narrowly lanceolate, gibbous at base.

Leaves filiform, terete, only slightly flattened above, erect; achenes dull, tan to light brown or reddish, roughened with clavellate or capitate hairs on body and wing, and with a central corky ridge, corky wing irregularly thickened

4. *C. californica*.

Leaves linear, grooved above, rounded beneath, spreading; achenes shining, body dark brown, smooth, glabrous or with a few coarse hairs or callous papillae, corky wing light tan, thin.

5. *C. Douglasii*.

Leaves flat, only slightly fleshy, pinnate or bipinnate into spatulate lobes 1-3 mm. broad, terminal lobe usually broadest; annulus of disc corollas mostly glabrous; outer involucre bracts linear to linear-spatulate, not gibbous at base

6. *C. Stillmanii*.

Perennials; stems stout, 3-30 dm. tall; coastal and insular. Section *Tuckermannia* (Nutt.) Blake.

Heads few (2-4) at ends of branches, on naked peduncles 15-50 cm. long; coastal San Diego County to northern Baja California and adjacent islands

7. *C. maritima*.

Heads numerous and cymosely clustered at ends of branches, on leafy peduncles 6-20 cm. long; coastal southern California and adjacent islands from San Luis Obispo County to Los Angeles County.

8. *C. gigantea*.

1. *COREOPSIS BIGELOVII* (Gray) Hall, Univ. Calif. Publ. Bot. 3: 141. 1907. *Pugiopappus Bigelovii* Gray, Pac. R. Rep. 4: 104. 1857. *P. Breweri* Gray, Proc. Am. Acad. 7: 660. 1873. *Leptosyne Bigelovii* Gray, Syn. Fl. 1, pt. 2: 300. 1884.

Erect, essentially glabrous annual with several (1-30, mostly 5-10) scapose stems from a taproot: scapes yellowish green to stramineous, somewhat leafy below and occasionally branching near base, sometimes with 1 or 2 appressed bracts above the leaves, monocephalous, 10-60 (mostly 25-30) cm. tall, usually stout: leaves 4-12 cm. long, alternate, basally clustered, only slightly fleshy, flattened, lightly grooved above, rounded below, somewhat glaucous, spreading; blade ovate, 2-8 cm. long, once or twice pinnate into linear, obtuse, often callous tipped lobes 5-30 mm. long and 1-2 mm. wide, rachis as wide as lobes; petiole 1-5 mm. long, 1-2 mm. wide, channelled, expanded at base, sometimes irregularly margined with minute glandular capitate hairs: heads erect, 1-1.5 cm. high, 2-4.5 cm. wide: involucre glabrous, cylindric or slightly barrel shaped, with sharply truncate base; bracts of outer series 4-7, linear, 5-12 mm. long (often longer than inner bracts), dark green, glaucous to shining, slightly fleshy, mostly loosely spreading from base; bracts of inner series 6-8, ovate, 6-10 mm. long, 3-6 mm. wide; acute with apical tuft of hyaline hairs, greenish yellow, shining, many nerved, scarious margined, erect or sometimes with tips spreading, reflexed in fruit: ray florets 5-10, mostly 8, pistillate, fertile; ligule golden yellow, obovate, 5-25 (mostly 15) mm. long, 3-12 (mostly 8) mm. wide, with truncate and erose apex, spreading horizontally; tube 2 mm. long with scattered glandular capitate hairs; style branches linear, obtuse: disc florets 20-50, perfect, golden yellow, all fertile, or the central sometimes sterile; tube 2 mm. long; annulus glandular pubescent; throat expanded, 1.5 mm. long; corolla lobes triangular ovate, acute, glandular papillate, spreading; anther tips ovate cordate; style tips triangular acute, glandular papillate; pollen grains spherical, with short spines: receptacular bracts lanceolate to oblanceolate, 4-10 (mostly 5-8) mm. long, 1 mm. broad, subacute to acute, hyaline, slightly callous thickened on midrib, exceeding body of disc achenes and often equalling the pappus palea, closely adhering to back of and persistently attached to base of disc achenes: ray achenes obcompressed, oblong to obovate, 3-5 mm. long, 2 mm. wide, glabrous, epappose; body brown or mottled with tan, often almost covered with tan, corky, microscopically foveolate roughenings, flat or somewhat ridged on inner face, rounded on back; marginal callous wing narrow, smooth or corky roughened similarly to but more densely than body: disc achenes obcompressed, oblong to oblanceolate, 4-6 mm. long, 1-1.5 mm. wide; body dark brown, sometimes mottled with tan, shining, microscopically latticed, truncate at base with an evident callous; back



completely glabrous, covered with the persistent receptacular bract; inner face flat or with slight central ridge, glabrous except for a central row of more or less prominent cilia similar to but shorter than marginal cilia; marginal cilia silky, white, upwardly directed, two-celled, microscopically bidentate at apex, 1–1.5 mm. long; pappus palea of two, persistent, lanceolate, triquetrous, acuminate, hyaline, denticulate membranes 2 (or 3) mm. long.

Range. Desert and cismontane areas of southern California and the southern Sierra Nevada of California, altitude 150–1500 m.; from San Diego County north to Tulare County, west to Santa Barbara County, and north to southern Monterey County.

Type. "On the Mohave Creek, in the desert east [west] of Colorado," March, 1854, *J. M. Bigelow*.

Specimens examined. San Diego County: Colorado Desert, *W. G. Wright* (UC). Riverside County: near Banning, April 23, 1922, *M. F. Spencer 2040* (P). San Bernardino County: Barstow, May 1, 1922, *M. F. Spencer 1954* (P); 7 miles east of Daggett, April 6, 1924, *P. A. Munz and D. Keck 7842* (P); Mescal Creek, April 29, 1902, *H. M. Hall 3027* (UC); Cajon Pass, May, 1905, *H. M. Hall 6219* (UC); Trona road, May 8, 1937, *Annetta Carter 1305* (UC). Los Angeles County: Mandeville Canyon, March, 1929, *I. W. Clokey and B. Templeton 4520* (P); Saugus, April 23, 1903, *G. B. Grant 5424* (P, UC); Antelope Valley, May 1–3, 1902, *H. M. Hall 3074* (UC); 5 miles south of Muroc, April 1, 1932, *H. L. Mason 6882* (UC); between Rock Creek and Little Rock Creek, April 27, 1926, *H. L. Mason 3046* (UC). Kern County: between Mohave and Lancaster, April 20, 1930, *H. L. Mason 5567* (UC); Greenhorn Range, June 2–10, 1904, *H. M. Hall and H. D. Babcock 5078* (UC); Kern Canyon, April 12, 1905, *A. A. Heller 7662* (UC); vicinity of old Fort Tejon, June 16–19, 1905, *H. M. Hall 6307* (UC). Inyo County: April 17, 1891, *T. S. Brandegee* (UC); 10 miles sw. of Shoshone, April 17, 1932, *C. L. Hitchcock 12340* (P, UC); Argus Mountains, April 18, 1930, *Harold Bailey and W. Robison* (P, UCLA, UC). Tulare County: near Oak Grove, April 23, 1925, *R. Bacigalupi 1209* (P); Kaweah River Basin, April, 1901, *Ralph Hopping 38* (UC); Tule River, March 22, 1925, *P. A. Munz 9136* (P). Ventura County: Pine Creek near Sespe, March 24, 1917, *B. W. Everman* (CA). Santa Barbara County: Figueroa Mountain, May 31, 1929, *Ralph Hoffmann* (SBM); Dutch Flat, San Rafael Mountains, June 8, 1929, *Ralph Hoffmann* (SBM); trail to Zaca Peak, June 19–30, 1906, *Alice Eastwood 585* (CA). Monterey County: north of Parkfield, March 24, 1925, *P. A. Munz 9186* (P).

*Coreopsis Bigelovii* was described by Gray as having the annulus of the disc corollas beardless. A similar interpretation was given by Hall and also by Jepson (Man. Fl. Pl. Calif. 1084, 1085. 1925) who uses the beardless annulus as one of the char-

acters distinguishing *C. Bigelovii* from *C. calliopsidea*. Blake, after an examination of the type of *C. Bigelovii*, states (*op. cit.*, p. 341): "The annulus of the disk-flowers, in the types and other specimens examined, is very distinctly bearded, not glabrous as originally described and as repeated in the Synoptic Flora and by Hall." The specimens cited above verify this observation of Blake's, though in some of the specimens the ring of hairs is not complete.

2. *Coreopsis hamiltonii* (Elmer) comb. nov. *Leptosyne hamiltonii* Elmer, Bot. Gaz. 41: 323. 1906.

Erect, essentially glabrous annual with several (1-30, mostly 8-10) scapose stems from a taproot: cotyledons linear, 1.5 cm. long, 1 mm. wide, flattened, spreading: scapes reddish, somewhat leafy below and occasionally branching near base, sometimes with a small, appressed bract above the leaves, monocephalous, 6-25 (mostly 10-15) cm. tall: leaves 1-5 cm. long, alternate, basally clustered, fleshy, flattened and lightly grooved above, rounded below, glaucous, spreading; blade triangular ovate, 0.5-2 cm. long, often as wide, twice pinnate into linear, obtuse and sometimes callous tipped lobes 1 mm. wide; petiole 1-3 cm. long, 2 mm. wide, strongly grooved above, expanded at base: heads erect, 7-10 mm. high, 10-20 mm. wide: involucre glabrous, cylindric or somewhat barrel shaped, with sharply truncate base; bracts of outer series 4-7, linear, 3-6 mm. long, always shorter than inner series, obtuse, dark green occasionally spotted with red, glaucous to shining, slightly fleshy, appressed to inner bracts and spreading only near tips; bracts of inner series 6-8, broadly lanceolate or narrowly ovate, 5-8 mm. long, 2-3 mm. wide, acute with apical tuft of hyaline hairs, greenish yellow, shining, thin, many nerved, narrowly scarious margined, appressed or sometimes with tips spreading, reflexed in fruit: ray florets 5-8, pistillate, fertile; ligule golden yellow, oblong to obovate, 3-8 mm. long, 2-5 mm. wide, obscurely 3-toothed at the truncate apex, strongly reflexed; tube 1.5-2 mm. long with incomplete ring of short, yellowish, glandular capitate hairs near apex; style branches linear, obtuse: disc florets 20-30, perfect, golden yellow, central ones sterile; tube 1-2 mm. long, annulus glandular pubescent; throat expanded, 1.5-2 mm. long; corolla lobes triangular ovate, acute, glandular papillate, spreading; anther tips ovate cordate; style tips triangular acute, glandular papillate; pollen grains spherical, with short spines: receptacular bracts linear, 5-6 mm. long, 1 mm. broad, obtuse, hyaline, falling separately from disc achenes: ray achenes obcompressed, meniscoid, obovate, 5 mm. long, 3 mm. wide, dark brown or tan spotted with brown, smooth, glabrous and shining, rounded on back, flat on inner face with slight central keel epappose; marginal wing thin, smooth, tan marbled with brown: disc achenes obcompressed, narrowly obovoid, 5-6 mm. long, 1.5-2 mm. broad,

smooth, tan marbled with brown, truncate at base with slight callous, rounded on both sides, the inner face with slight central ridge or keel, both faces covered (sometimes sparsely so) with persistent, upwardly directed, silky, white, two-celled cilia 1 mm. long, which are microscopically bidentate at apex and often swollen at base, the marginal cilia thicker, more spreading, and up to 1.5 mm. long; pappus palea of two, persistent, obovoid, triquetrous, triangular acute, hyaline, denticulate membranes 1 mm. long.

Range. Exposed, dry rocky slopes of Santa Clara County in the Mount Hamilton Range of the inner South Coast Ranges of California, altitude 600–1295 meters.

Type. Mount Hamilton, Santa Clara County, California, April, 1900, *A. D. E. Elmer* 2328. The collector comments as follows: "It was in fine flower and fruit, and grew in dry gravelly soil on a steep slope a few hundred yards below the observatory. Since then I have failed to find it either in this same place or elsewhere."

Specimens examined. Santa Clara County: Mount Hamilton, April 29, 1923, *Alice Eastwood* 11671, topotype (CA); Copernicus Peak, highest point of Mount Hamilton, altitude 4250 feet, April 15, 1934, *H. K. Sharsmith* 914, topotype, representative of the species (UC); April 28, 1935, *H. K. Sharsmith* 1839, topotype (UC); Mount Hamilton-Livermore road, April 28, 1925, *Alice Eastwood* 12468 (CA); eight miles from Mount Hamilton on road to San Antonio Valley, April 6, 1930, *J. T. Howell* 4665 (CA), April 6, 1930, *E. K. Crum* 602 (UC); San Antonio Valley, March 23, 1932, *H. E. Wieser* (SU); Arroyo Bayo, March 30, 1935, *H. K. Sharsmith* 1709, April 2, 1936, 3489, April 25, 1936, 3628 (UC).

*Coreopsis hamiltonii* has been overlooked as a specific entity ever since Elmer's description of it in 1906. The only recent reference occurs in Blake's paper (*op. cit.*, p. 341), in which the original combination (*Leptosyne hamiltonii* Elmer) is given as a synonym under *C. Bigelovii*; no specimens are cited and no locality is mentioned. Elmer's original description of *C. hamiltonii* is detailed in content and presents, in general, an adequate picture of the species. It is in error, however, regarding the achenes, which are described as "ciliate on the edges, pubescent on the sides, brown and glabrous when mature: pappus of two caducous hyaline finely ciliate membranes." Actually, the achenes are dimorphic, those of the ray differing strongly from those of the disc.

3. *COREOPSIS CALLIOPSIDEA* (DC.) Gray, Bot. Mex. Bound. 90. 1859. *Agarista calliopsidea* DC. Prod. 5: 569. 1836. *Pugio-pappus calliopsidea* Gray, Proc. Am. Acad. 8: 660. 1873. *Leptosyne calliopsidea* Gray, Syn. Fl. 1, pt. 2: 300. 1884. *L. calliopsidea* var. *nana* Gray, loc. cit.

Erect, essentially glabrous, usually rather stout annual with

several (1-30 or more, mostly 4-6) stems from a taproot: stems yellowish green to stramineous, usually leafy to the middle or even above, sometimes almost naked, sometimes branching near the base, occasionally branching above, monocephalous, 8-55 (mostly 20-30) cm. tall: leaves 4-8 cm. long near base, reduced above, alternate, somewhat clustered at base or quite scattered on stems, only slightly fleshy, lightly grooved above, rounded beneath, somewhat glaucous, spreading; blade ovate, 1-5 cm. long, once or twice pinnate into linear, obtuse, divergent lobes 0.5-2 mm. wide and often callous tipped, rachis as wide as lobes or up to 5 mm. wide, upper leaves sometimes simple; petiole 1-5 cm. long, 0.5-5 mm. wide, channelled, expanded at base: heads erect, showy, 1-2 cm. high, 2-9 cm. wide: involucre campanulate, united at base into a disc 3-10 mm. across, this disc glabrous or with a few, scattered glandular hairs; bracts of outer series 5 (occasionally 4 or 6), deltoid ovate with a broad base, 3-8 mm. long, almost as wide to wider, acute and sometimes callous tipped, green, glaucous, flat, not fleshy, margined occasionally with short glandular capitate hairs, somewhat spreading; bracts of inner series mostly 8 (occasionally 6 or 7), ovate with a broad base, 8-10 mm. long, exceeding the outer series, acute with a minute, apical tuft of hyaline hairs, greenish yellow, shining, thin, narrowly scarious margined, many nerved, somewhat spreading: ray florets mostly 8 (occasionally 6 or 7), pistillate, fertile or often sterile; ligule golden yellow, obovate, 10-35 mm. long, 5-18 mm. broad, with truncate erose apex, spreading horizontally; tube 3 mm. long, essentially glabrous; style branches linear, obtuse: disc florets 15-50, perfect, golden yellow, usually all fertile; tube 2 mm. long, with scattered glandular hairs; annulus heavily bearded with glandular hairs; throat funnelform, 2 mm. long; corolla lobes lanceolate, 1 mm. long, acute, glandular papillate, spreading; anther tips lanceolate cordate; style tips triangular acuminate, glandular papillate; pollen grains spherical, with short spines; receptacular bracts lanceolate to oblanceolate, 6-7 mm. long, 1-1.5 mm. wide, acuminate to apiculate, hyaline, the midrib callous thickened, scale equalling or scarcely exceeding body of disc achene, closely adhering to its dorsal surface and persistently attached to its base: ray achenes (if developed) obcompressed, oval, 5-6 mm. long, 3-4 mm. wide, glabrous, epappose; body tan or brown, smooth or sometimes almost covered with a rough, tan callous, flat or somewhat ridged on inner face, rounded on back; marginal wing smooth, stramineous, flat: disc achenes obcompressed, linear to oblanceolate, 6-7 mm. long, 1.5 mm. wide; body dark brown, shining, microscopically latticed, rounded at base with an evident callous; inner face flat, covered with upwardly directed, silky, white or tawny, two-celled cilia 1 mm. long and microscopically bidentate



at apex; back somewhat rounded, completely glabrous, covered with the persistent receptacular bract; marginal cilia thicker, 2-3 mm. long; pappus palea of two, persistent, lanceolate, triquetrous, acuminate, hyaline, denticulate membranes 2.5-5 (mostly 4) mm. long.

Range. Western portion of the Mohave Desert in San Bernardino County and Kern County; west to eastern San Luis Obispo County; north on extreme eastern side of inner South Coast Ranges to Corral Hollow, Mount Hamilton Range, Alameda County, altitude 210-1070 meters.

Type. "In California legit cl. Douglas."

Specimens examined. San Bernardino County: Mohave Desert, May, 1882, *C. G. Pringle*, isotype of *C. calliopsidea* var. *nana* Gray (UC); Crutts Post Office, May 14, 1922, *I. M. Johnson* 6475 (UC); Fremont's Peak, May 6, 1906, *H. M. Hall and H. P. Chandler* 6868, 6869 (UC); near Palmdale, March 28, 1931, *F. A. MacFadden* 2574 (UC). Kern County: Mohave Station, June 3, 1915, *S. B. Parish* 9771 (UC); Randsburg, April 5, 1927, *Craig, Newsom, Hilend* 129 (P); Bakersfield, April 4, 1893, *Alice Eastwood* (UC). Los Angeles County: 3 miles west of Muroc, Mohave Desert, April 2, 1932, *H. L. Mason* 6895 (UC). Santa Barbara County: Cuyama, White Hills, May 2, 1896, *Alice Eastwood* (UC). San Luis Obispo County: Carrizo Plains, April 1, 1934, *E. Armstrong* 1102 (VTM). Fresno County: Alcalde, April, 1891, *T. S. Brandege* (UC); Panoche Creek, April 1, 1932, *C. H. Quibell* 2799a (P). Stanislaus County: Arroyo del Puerto, Mount Hamilton Range, altitude 730 feet, March 29, 1935, *H. K. Sharsmith* 1593 (UC). Alameda County: Tesla, April 11, 1935, *J. T. Howell* 12598 (CA); Corral Hollow, April 21, 1935, *A. M. Carter* 777 (UC).

*Coreopsis calliopsidea* is the only one of the annual species here treated in which the stems are always somewhat leafy. Basal clustering of the leaves may be quite absent, and the stems may be clothed with scattered leaves for their greater length, or the upper half or two-thirds of the stems may be essentially naked. *Coreopsis calliopsidea* var. *nana* Gray was based on small plants in which the leaves are somewhat basally crowded, and the stems more scapose than usual. In Hall's treatment (*op. cit.*, p. 141) the outer disc achenes are described as being like those of the ray, oval, flat, and glabrous, the central disc achenes as being narrow with long cilia. The dimorphism, however, is sharply defined between achenes of ray and disc, in this species as in the other members of the section *Pugiopappus*. Only the ray achenes are glabrous, and all of the disc achenes are ciliate.

4. *Coreopsis californica* (Nutt.) comb. nov. *Leptosyne californica* Nutt. Trans. Am. Phil. Soc. n. ser. 7: 363. 1841. *L. Newberryi* Gray, Proc. Am. Acad. 7: 358. 1868. *L. Douglasii* of

Gray and other authors, not *L. Douglasii* DC. *Coreopsis Douglasii* Hall, Univ. Calif. Publ. Bot. 3: 140. 1907 (misapplied).

Erect, essentially glabrous annual with several (1–20, mostly about 5) scapose stems from a slender taproot: cotyledons linear filiform, 3–4 cm. long, obtuse with a conspicuous red callous tip, fleshy, terete or slightly flattened above, erect: scapes slightly reddish, somewhat leafy and occasionally branching near base, often with a small, appressed bract above the leaves, monocephalous, 5–45 (often 20–25) cm. tall: leaves basally clustered, erect, linear filiform, 2–10 (or 15) cm. long, 0.5 mm. wide, obtuse with a conspicuous red callous tip, fleshy, terete or slightly flattened above, mostly entire, occasionally with 1–2 small, linear pinnae, glabrous except for an occasional, short, glandular capitate hair: heads erect and solitary, 6–10 mm. high, 10–35 mm. broad: involucre barrel shaped with rounded base; bracts of outer series 2–7, pale green, sometimes blotched with red, prominently bearded at gibbous base with yellow or red glandular papillae, slightly fleshy, narrowly lanceolate, 4–7 mm. long, 1 mm. wide, obtuse with a red callous tip, spreading; bracts of inner series 5–8 (or 10), broadly lanceolate to narrowly obovate, 6–10 mm. long, 2–4 mm. wide, acute with tuft of apical hyaline hairs, yellow green often blotched with red, thin, many nerved, narrowly scarious margined, constricted at middle with upper half spreading in anthesis, connivent in early fruit, spreading in age: ray florets 5–12, pistillate, fertile; ligule yellow, sometimes paler near apex, narrowly to broadly obovoid, 5–15 mm. long, 3–8 mm. wide, strongly 3-toothed at apex, spreading horizontally; tube 1–1.5 mm. long with apical ring of brownish or yellowish glandular papillae; style branches linear, obtuse: disc florets 10–30, perfect, yellow, central ones often sterile; tube 1–2 mm. long; annulus glandular pubescent with yellowish or brownish hairs; throat expanded, 2 mm. long; corolla lobes broadly ovate, acute, spreading; anther tips ovate cordate; style tips triangular, attenuate, glandular papillate; pollen grains spherical, with short spines; receptacular bracts linear to spatulate, 4–55 mm. long, 1–1.5 mm. broad, obtuse, hyaline, lightly nerved, not falling with disc achenes and often more tardily deciduous: achenes monomorphic, obcompressed, obovate, 2.5–5 mm. long, dull and microscopically papillate, roughened with short, hyaline, two-celled, clavellate or capitate hairs on wing and body, rusty-tan to light brown, tardily deciduous; pappus reduced to a cupule; marginal wing of achene colored like body or slightly lighter, strongly and irregularly corky thickened and spongy, microscopically foveolate, with marginal row of hyaline, two-celled, clavellate or capitate hairs and often with row of 1 to several red spots on inner edge; body of achene rounded on back, inner face with a well developed, central corky ridge; central

sterile achenes varying to thin, smooth, somewhat shining, only sparsely hairy, usually with clavellate hairs forming an obvious marginal fringe on the wing, light tan or stramineous, often with conspicuous and numerous red spots along inner edge of wing.

Range. Cismontane southern California, Mohave Desert and Colorado Desert, from southeastern Santa Barbara County to San Diego County, altitude 30–600 meters; south to northwest Lower California, east to southern Arizona.

Type. "Near San Diego. Upper California," *Nuttall*.

Specimens examined. CALIFORNIA. Santa Barbara County: Le Cumbre Club, *R. C. and J. Robbins* in 1921 (SBM). Los Angeles County: Little Rock, April 26, 1926, *H. L. Mason 3003* (UC); Lancaster, April 1, 1932, *H. L. Mason 6872* (UC); Pasadena, May 2, 1882, *Marcus E. Jones 3361 pro parte, 3373* (P); Claremont, May 20, 1909, *L. Abrams 5325* (SU); Cobal Canyon, March 16, 1925, *P. A. Munz 9357* (P); near Santa Ana Canyon, March 10, 1926, *M. E. Jones* (P); Altadena, April, 1902, *G. B. Grant 681* (UC); Verdugo Hills, April 6, 1901, *L. Abrams 1387* (SU). Orange County: Santa Ana Mountains, April, 1904, *H. D. Geis 732* (SU). Kern County: El Paso Range, May 1, 1927, *L. R. Abrams 11915* (P); 10 miles east of Mohave, April 2, 1932, *H. L. Mason 6906* (UC); between Rosamund and Mohave, April 30, 1927, *L. R. Abrams 11788* (P, SU); between Coso Hot Springs and Coso Junction, April 30, 1928, *R. S. Ferris 7466* (P). San Bernardino County: north of Box S Ranch, April 21, 1932, *P. A. Munz 12415* (P, UC); between Warren's Well and Coyote Well, April 18, 1930, *J. A. Ewan 3057* (UC); 20 miles northwest of Barstow, May 5, 1906, *H. M. Hall and H. P. Chandler 6850* (UC); west of 29 Palms, April 10, 1935, *P. A. Munz 13774* (P); summit Cajon Pass, April 12, 1919, *S. B. Parish 19237* (UC). Riverside County: Riverside, April 4, 1902, *H. M. Hall 2960* (UC); se. of White Tanks, April 9, 1932, *P. A. Munz and C. L. Hitchcock 12224* (P, UC). Imperial County: Coyote Canyon, April, 1902, *H. M. Hall 2859* (UC, SU). San Diego County: San Diego, April 21, 1903, *H. M. Hall 3860* (UC); Del Mar, March 28, 1894, *T. S. Brandegees* (UC); Point Loma, April 6, 1913, *Alice Eastwood 2533* (CA); Jacumba Springs, April 11–16, 1924, *W. W. Eggleston 19748* (P). ARIZONA. Arnett Canyon, Pinal County, March 19, 1932, *J. W. Gillespie 5420* (UC); Apache Trail, March 6, 1929, *Mrs. C. W. McKelvey* (CA). MEXICO. Baja California: Northwest corner Baja California, April, 1903, *H. M. Hall 3973* (UC); San Quintin, February 15, 1935, *C. Epling and W. Robison* (UCLA); Todos Santos Bay, April 10, 1882, *M. E. Jones* (SU).

From the time of Gray to the present, the southern Californian species described above as *C. californica* has been known, first, as *Leptosyne Douglasii*, and later, as *Coreopsis Douglasii*. Soon after beginning the present study it became evident that there are two species among the plants recognized as *C. Douglasii*,

the most outstanding differences being in the fruits. Through the courtesy of Sir Arthur Hill, two fruits from the type of *Leptosyne Douglasii* DC. were sent for comparison from the Royal Botanic Gardens at Kew. Though somewhat immature, these fruits belong unquestionably, not to the widely spread and well known southern California unit under consideration, but to the relatively restricted and hitherto unrecognized unit of the inner South Coast Ranges. The name *C. Douglasii* must be transferred, then, from its old and well-known association with the southern Californian species, to the South Coast Range species. It follows that *Leptosyne californica* must be reestablished as the type of the southern Californian species.

According to Nuttall's description of *Leptosyne californica*, the ray achenes are imperfectly developed and almost smooth, but the disc achenes are scabrous with short, glandular hairs, and have, as well, thick, spongy margins and often a similarly enlarged center. *Leptosyne Newberryi* Gray, described from material collected by Newberry at Sitgreaves Pass, Arizona, and by Palmer at Camp Grant, Arizona, represents a phase in which the achenes are only sparsely clad with clavellate hairs. These minor achenal differences give evidence of the variations to be expected in the achenes of *C. californica*. If only the extremes are considered, the differences are striking. The variation is not, however, one of regional significance, but seems, rather, to be related to fertility within the individual head. The central disc florets of this species are more or less sterile and vary from the fertile ray and outer disc achenes in the manner indicated in the description of the species. Both extremes may be present in the same head, or the more fertile type may be quite lacking.

When there is taken into consideration the wide range of climatic and edaphic factors to which *C. californica* is exposed, the size variation which occurs within the species is not surprising. The species is sufficiently plastic to adapt itself to habitat conditions as diverse as the Mohave Desert and the seacoast mesas of San Diego County. The maritime form often has the basal leaves thickly clustered, and the scapes stout and rather low with large and showy heads.

5. *COREOPSIS DOUGLASHI* (DC.) Hall, Univ. Calif. Publ. Bot. 3: 140. 1907 (as to name but not as to description). *Leptosyne Douglasii* DC. Prod. 5: 531. 1836. *C. Stillmanii* var. *Jonesii* Sherff, Bot. Gaz. 97: 605. 1936.

Erect, essentially glabrous, glaucous annual with several (1-12, mostly 2-5) stems from a slender taproot: cotyledons linear, 2-5 cm. long, obtuse with an inconspicuous red callous tip, fleshy, rounded beneath, flattened and lightly grooved above, spreading: stems reddish, scapose, somewhat leafy and occasionally branching near base, sometimes with a small, appressed bract



above basal leaves, monocephalous, 5-25 (mostly 15) cm. tall, glabrous or with an occasional, short, glandular capitate hair: leaves alternate, basally clustered, spreading when young, sub-erect to erect with age, linear, 2-8 cm. long, 1 mm. wide, obtuse with an inconspicuous red callous tip, fleshy, rounded beneath, flattened and lightly grooved above, entire or with 1-2 linear pinnae 3-10 mm. long, glabrous except for lateral rows of widely scattered, short, glandular-capitate hairs: heads often nodding in bud, erect in flower, 6-10 mm. high, 10-25 mm. broad; involucre barrel shaped with rounded base; bracts of outer series 2-7, pale green, inconspicuously bearded with short, yellowish glandular papillae at gibbous base, slightly fleshy, narrowly lanceolate, 4-7 mm. long, 1 mm. wide, obtuse, spreading; bracts of inner series 5-8, obovate, 6-10 mm. long, 3-4 mm. wide, acute with apical tuft of hyaline hairs, pale green to yellowish or reddish green, thin, many nerved, narrowly scarious margined, constricted at middle with upper half spreading in anthesis, connivent in early fruit, spreading in mature fruiting heads: ray florets 5-8, pistillate, fertile; ligule golden yellow, sometimes paler near apex, oval, 5-8 mm. long, 3-5 mm. wide, weakly 3-toothed at apex, spreading horizontally, tube 1.5-2 mm. long with hairy ring of glandular hairs at apex; style branches linear, obtuse: disc florets 10-30, perfect, golden yellow, central ones often sterile; tube 1.5-2 mm. long; annulus glandular pubescent; throat expanded, 2 mm. long; corolla lobes broadly ovate, acute, glandular papillate, spreading; anther tips ovate cordate; style tips triangular, attenuate: pollen grains spherical, with short spines: receptacular bracts linear, 4-5 mm. long, 1-2 mm. wide, obtuse, hyaline, lightly nerved, falling separately from disc achenes: achenes monomorphic, obcompressed, obovate, menisoid, 2.5-5 mm. long, essentially glabrous, smooth, somewhat tardily deciduous; pappus reduced to a cupule; marginal wing yellowish to stramineous, occasionally tan or brownish, 1 mm. wide, somewhat corky but scarcely thickened, microscopically foveolate, glabrous (very rarely with a hair or two), without red spots (very rarely with one or two) on inner margin; body of achene dark brown, shining, microscopically latticed, rounded on back, smooth on inner face or with a few, small, central or scattered, inconspicuous, callous papillae, and occasionally with some small, appressed, two-celled, scarcely clavellate or capitate hairs; central sterile achenes similar to but smaller than fertile ones.

Range. Dry rocky slopes of the inner South Coast Ranges of California, Santa Clara County to western and central Santa Barbara County, altitude 150-600 meters; Mount Hamilton Range, San Carlos Range, southern Gabilan Range, southeastern Santa Lucia Mountains, western San Rafael Mountains.

Type. "In California legit cl. Douglas."

Specimens examined. California, *Douglas 8*, achenes from type at Herb. Kew. (UC). Santa Clara County: Arroyo Bayo, Mount Hamilton Range, altitude 2000 feet, April 2, 1936, *H. K. Sharsmith 3490*, flowering specimens typical (UC), April 25, 1936, *H. K. Sharsmith 3627*, achenes typical (UC), May 15, 1937, *H. K. Sharsmith 3944, 3946* (UC). San Benito County: Hernandez Valley, May 1, 1933, *Roxanna S. Ferris 8394* (UC, SU). Monterey County: Priest Valley, May 13, 1893, *Alice Eastwood* (UC); Jolon, Bradley road near Bryson road junction, May 2, 1933, *Roxanna S. Ferris 8454* (UC, SU); Bradley-Jolon road near Pleyto road junction, May 3, 1933, *D. D. Keck 2098* (P); Jolon, *T. S. Brandegees* in 1876 (UC); top of Jolon grade, March 24, 1935, *Alice Eastwood and J. T. Howell 1966* (CA); summit of Mustang grade, March 26, 1935, *Alice Eastwood and J. T. Howell 2085* (CA); Mansfield Ranch, King City, April 1, 1915, *Alice Eastwood 4022* (CA). San Luis Obispo County: Paso Robles, May 4, 1926, *Alice Eastwood 13858* (CA). Santa Barbara County: Lompoc, April 16, 1932, *Ralph Hoffmann* (SBM); Zaca Mountain, March 25, 1935, *D. Axelrod 143*, immature (VTM).

The identification of De Candolle's type of *Leptosyne Douglasii* with the South Coast Range species under consideration, and the necessary transfer to this species of the name *C. Douglasii*, previously misapplied to *C. californica*, has been discussed under the latter species. The exact locality in California from which Douglas collected the type of *Leptosyne Douglasii* is unknown, but a number of Douglas' collections indicate that he penetrated the inner South Coast Ranges, and it is probable that he obtained it either east of Monterey or north and east of Santa Barbara. The description of *C. Douglasii* as given above has been based upon living plants from the Mount Hamilton Range.

Because of its close alliance with the far more abundant *C. californica*, *C. Douglasii* has remained unnoticed by the very few California botanists who have collected it. It is important to realize that the vegetative features which help to distinguish this species are to be adequately recognized only in the living plants. In herbarium specimens only the achenal characters stand out as distinctive (*H. K. Sharsmith 3946*). It should be noted also that the younger living plants show the characteristic leaf position, shape, and glaucous cast far more clearly, the leaves becoming more terete and flaccid with maturity. To a certain degree the quite young plants maintain their vegetative characters even when pressed (*Ferris 8394*, SU).

*Coreopsis Stillmanii* var. *Jonesii* was based on a collection made May 2, 1882, at Pasadena, California (*Marcus E. Jones 3361 pro parte*). Although the wings of some of the achenes do show a certain amount of corky and rugose thickening suggestive of *C. Stillmanii*, varietal relationship to this species is not indicated.

On the basis of leaf and floral characters, *C. Stillmanii* var. *Jonesii* is referable either to *C. californica* or to *C. Douglasii*; the achenes are those of *C. Douglasii*. Pasadena is far removed from the range of *C. Douglasii* as otherwise known. A suspected error in locality is partially confirmed by the inter-mixture of specimens of *C. californica* on the two duplicate sheets (P, CA) of the type collection. Another collection of the same locality and date (*Jones 3373*, P) consists of one plant of *C. californica*. The suspected error is further confirmed by examination of available Los Angeles County specimens of the section *Euleptosyne*; all are found to belong, on the basis of achenal characters, to *C. californica*. In a region as well known botanically as the area about Pasadena, it is significant that none of the many local collectors has ever reported any species which would correspond to *C. Douglasii*. Mr. Frank W. Peirson, who has made a special study of the Pasadena flora, states that he has never collected any *Coreopsis* with such achenal characters. In consideration of these facts, it seems necessary to conclude that these Jones Pasadena specimens do not represent a part of the geographic range of *C. Douglasii*.

6. COREOPSIS STILLMANII (Gray) Blake, Proc. Am. Acad. 49: 342. 1913. *Leptosyne Stillmanii* Gray, Bot. Mex. Bound. 92. 1859.

Erect, essentially glabrous annual with several (1-15, mostly 3-5) stems from a tap root: cotyledons 1 cm. long, spatulate, flattened, only slightly fleshy, spreading: stems yellowish green to stramineous, leafy on lower half or scapose, sometimes branched, occasionally with a small, appressed bract on upper portion, monocephalous, 5-30 (mostly 10-15) cm. tall: leaves 2-10 cm. long, alternate, clustered at base or mostly cauline, only slightly fleshy, flat, spreading; blade triangular, 0.5-5 cm. long, often as wide, once or twice pinnate into spatulate, obtuse lobes 1-3 mm. wide and often inconspicuously callous tipped, terminal spatulate lobe usually broader than the lateral pinnae, blade simple in depauperate plants; petiole 1-5 cm. long, 1-2 mm. wide, channelled, sometimes margined with scattered glandular capitate hairs, expanded at base: heads erect, 7-20 mm. high, 1-3.5 mm. wide: involucre barrel shaped, rounded at base; bracts of outer series 4-8, linear to spatulate, 3-10 cm. long, 1-2.5 (mostly 1.5) mm. wide, obtuse, green or reddish green, flat, not fleshy, somewhat spreading, angled but not gibbous at base, prominently bearded at base with long (1 mm.), brownish glandular hairs, similar but shorter hairs scattered along margins; bracts of inner series 5-10, ovate, 5-10 mm. long, 2-5 mm. wide, often lightly angled on midrib, acute with apical tuft of hyaline hairs, greenish yellow, shining, thin, many nerved, narrowly scarious margined, constricted two-thirds from base,

tips spreading in anthesis, connivent in early fruit, spreading in age: ray florets 5–8, pistillate, fertile; ligule orange yellow, obovate, 5–15 mm. long 3–8 mm. broad, deeply 3-toothed at apex, spreading horizontally; tube 1–1.5 mm. long, glabrous or with a few, scattered glandular hairs; style branches linear, obtuse: disc florets 10–40, perfect, orange yellow, usually all fertile; tube 1.5 mm. long; annulus glabrous or with a few glandular hairs; throat expanded, 1.5 mm. long; corolla lobes triangular ovate, acute, glandular papillate, spreading; anther tips ovate cordate; style tips triangular acute, glandular papillate; pollen grains spherical, with short spines: receptacular bracts lanceolate, 5–6 mm. long, 2 mm. broad, obtuse or subacute, hyaline, caducous, not falling attached to disc achenes: achenes monomorphic, obcompressed, obovate, 2.5–5 mm. long, 1.5–2.5 mm. wide; pappus reduced to a cupule or occasionally with 1–2 short, rigid awns from rim of cupule; marginal wing stramineous, glabrous, corky thickened, rugose, microscopically foveolate, erose margined; body of achene dark brown, smooth but usually not shining, microscopically foveolate, back rounded and glabrous or with short, scattered, two-celled, not obviously clavellate hairs which often arise from callous papillae, inner face with a usually well developed central row of callous papillae, also with smaller, scattered papillae bearing short hairs.

Range. Arid foothills on either side of the Sacramento Valley and San Joaquin Valley, altitude 30–900 meters; western slope of the Sierra Nevada from Butte County to Tulare County, eastern side of the inner South Coast Ranges in Contra Costa County, Santa Clara County, and Stanislaus County.

Type. "In the Valley of the Upper Sacramento," *Stillman*.

Specimens examined. Butte County: Iron Canyon, May, 1897, *Mrs. C. C. Bruce* 1987 (P). Placer County: Auburn, April 10, 1865, *W. H. Brewer* 4520 (UC). Tuolumne County: Coulterville, March 21, 1936, *H. L. Mason* 11019 (P, UCLA, UC); Chinese Camp, 1937, *C. W. Belshaw* 2782 (UC). Mariposa County: Mariposa, April 2, 1893, *J. W. Congdon* (UC). Madera County: Raymond, May 9, 1925, *Alice Eastwood* 12604 (CA); 8 miles west of Chowchilla, March 21, 1936, *R. F. Hoover* 821 (UCLA). Tulare County: April, 1897, *J. B. Davy*, achenes awned (UC). Contra Costa County: Antioch, April, 1889, *T. S. Brandegee* (UC). Santa Clara County: Seeboy Ridge, May 3, 1935, *H. K. Sharsmith* 1959 (UC), May 5, 1935, *H. K. Sharsmith* 3054, achenes awned in some heads (UC); San Antonio Creek, March 28, 1895, *E. I. Applegate* 259 (SU). Stanislaus County: Arroyo del Puerto, Red Mountains, March 30, 1935, *H. K. Sharsmith* 1689, April 21, 1935, *H. K. Sharsmith* 1818 (UC); Adobe Valley, April 22, 1936, *H. K. Sharsmith* 3536 (UC).

Plants of some colonies of *C. Stillmanii* have leaves entirely



or quite basal, and scapes unbranched and naked (*H. K. Sharsmith 3536*), while others show the basal leaves less densely clustered, and the lower part of the scapes with a few cauline leaves. The extreme of this latter condition is indicated when there is no basal cluster of leaves, and the branched scapes are strongly leafy up to half their length or more (*Belshaw 2782*). These variations appear, however, not to have any particular geographic significance. The condition of leafy stems has been used to differentiate *C. Stillmanii* from *C. californica* which has scapose stems, but this distinction does not hold.

7. *COREOPSIS MARITIMA* (Nutt.) Hook. Curtis Bot. Mag. t. 6241. 1876. *Tuckermannia maritima* Nutt. Trans. Am. Phil. Soc. n. ser. 7: 363. 1841. *Leptosyne maritima* Gray, Proc. Am. Acad. 7: 358. 1868.

Erect, robust, glabrous perennial 3-8 dm. high: stems stout, hollow, spreading from a thick woody base, much branched above: leaves alternate, fleshy, 5-25 cm. long, 2-3 times pinnate into often remote, linear, obtuse, flattened divisions 5-50 mm. long, 1-4 (mostly 2-3) mm. wide; rachis scarcely wider than divisions, flattened, extending into a petiole 2-15 cm. long and 2-3 mm. wide at base: heads few (2-3 at ends of branches), 1.5-2 cm. high, 6-9 cm. wide, erect on essentially naked peduncles 15-50 cm. long: involucre campanulate, rounded and fused at base into a disc 1 cm. across; bracts of outer series 6-10, oblong or oblong-ovate, 10-25 mm. long, 4-8 mm. wide, obtuse, green, flat, spreading to reflexed; bracts of inner series 10-15, ovate, 12-15 mm. long, subacute, thin, yellowish, many nerved, erect or with tips spreading: ray florets 15-20, pistillate, fertile; ligule golden yellow, elliptic to narrowly obovate, 25-40 cm. long, subentire to irregularly 3-toothed at apex, spreading horizontally; tube 3-4 mm. long, glabrous; style branches linear, obtuse; disc florets many, perfect, golden yellow, all fertile or central ones sterile, tube 2.5 mm. long; annulus glabrous or only weakly bearded with glandular papillae; throat funnelform, 3 mm. long; corolla lobes ovate, acuminate, thinly glandular papillate within; anther tips ovate, subcordate at base; style tips triangular acute, glandular papillate; pollen grains spherical, with short spines; receptacular bracts linear to oblanceolate, 8-12 mm. long, 1.5-3 mm. wide, subacute, midrib slightly callous thickened, falling separately from disc achenes: achenes monomorphic, obcompressed, oblong to obovate, 6-7 mm. long, 2-3 mm. wide, plane or slightly meniscoid, dark brown, smooth or often with microscopic surface papillae, seemingly glabrous but often with microscopic, hyaline hairs, inner face with slight central ridge, back rounded; marginal wing up to 1 mm. broad, thin, light brown to dark brown, smooth, microscopically latticed.

Range. Seacoast of southern California in San Diego

County; south along coast to northern Baja California and adjacent islands, altitude 3–60 meters.

Type. "On shelving rocks, near the sea at St. Diego, in Upper California." Nuttall.

Specimens examined. San Diego County: Del Mar, March 28, 1894, *T. S. Brandegee* (UC); La Jolla, April 16, 1904, *H. P. Chandler 5123* (UC); Point Loma, March 4, 1896, *T. S. Brandegee* (UC); Soledad, March 29, 1882, *M. E. Jones 3134* (P); San Diego, March, 1895, *T. S. Brandegee* (UC); Cardiff, May 9, 1924, *P. A. Munz 7955* (P). Baja California: Salado Cañon, April 27, 1893, *T. S. Brandegee* (UC); San Martin Island, March–June, 1897, *A. W. Anthony 216* (UC).

8. *COREOPSIS GIGANTEA* (Kellogg) Hall, Univ. Calif. Publ. Bot. 3: 142. 1907. *Leptosyne gigantea* Kellogg, Proc. Calif. Acad. Sci. 4: 198. 1873.

Erect, robust, glabrous perennial with a thick, fleshy main trunk 3–30 (mostly about 12) dm. high, up to 1 dm. thick; primary branches remote, club-like: leaves alternate, clustered at apices of branches, 3–25 cm. long, 3–4 times pinnate into many linear to linear filiform, apically truncate divisions 10–50 mm. long and 0.5–1.5 mm. wide which are lightly grooved above and rounded beneath; rachis stout, terete, lightly grooved above, extending into a petiole 30–70 mm. long and 3–5 mm. thick; heads 1–2 cm. high, 4–8 cm. wide, erect, numerous, cymosely clustered on somewhat leafy peduncles 6–20 cm. long at the ends of branches: involucre campanulate, rounded at base; bracts of outer series 5–12, lanceolate to oblong, 5–20 (mostly 8–10) mm. long, 2–4 mm. wide, obtuse, flat, green, spreading to reflexed; bracts of inner series 10–15, oblong ovate, 10–15 mm. long, 4–8 mm. wide, subacute, thin, yellowish, erect, many nerved with midrib often callous thickened below: ray florets 10–16, pistillate, fertile; ligule golden yellow, elliptic to narrowly obovate, 20–30 mm. long, 5–8 mm. wide, obtuse or subacute with entire or minutely and irregularly 3-toothed apex, spreading horizontally; tube 3–4 mm. long, glabrous; style branches linear, obtuse; disc florets many, perfect, golden yellow, all fertile, or central ones usually sterile; tube 2.5 mm. long; annulus glabrous or only weakly bearded with glandular papillae; throat funnelform, 3 mm. long; corolla lobes triangular acute, thinly glandular papillate within; anther tips narrowly ovate cordate; style tips triangular acute, glandular papillate; pollen grains spherical, with short spines: receptacular bracts linear, 8–10 mm. long, 1.5–2 mm. wide, midrib somewhat callous thickened on lower half, falling separately from disc achenes: achenes monomorphic, obcompressed, oblong to obovate, plane or slightly meniscoid, 5–6 mm. long, 2–3 mm. wide, glabrous or with a very few microscopic hairs, epappose; body dark brown, smooth, shining, microscopically latticed, inner face with slight central ridge, back rounded;

marginal wing narrow, thin, smooth, microscopically latticed, light brown or dark brown.

Range. Seacoast of southern California from San Luis Obispo County to Los Angeles County, both on mainland and adjacent islands, altitude 15–60 meters.

Type. "Cuyler Harbor, San Miguel Island, about 40 miles off the coast of Santa Barbara, Cal.," *W. G. W. Harford*.

Specimens examined. MAINLAND. San Luis Obispo County: Oso Flaco Lake, March 17, 1936, *H. C. Lee 514* (VTM). Santa Barbara County: Point Sal, April 11, 1936, *Annetta Carter 1095* (UC); five miles south of Surf, April 14, 1929, *R. S. Ferris 7572* (P, UC). Ventura County: foothills east of Hueneme, *W. G. Wright* in 1894 (UC); near Point Mugu, May 14, 1931, *C. B. Wolf 2052* (P, UC). Los Angeles County: Malibu Hills, April 26, 1926, *M. E. Jones* (P); Point Duma, March 7, 1898, *J. H. Barber 372* (UC). ISLANDS. Santa Rosa Island: April, 1901, *P. M. Jones* (UC); April 9, 1930, *P. A. Munz and E. Crow 11750* (P). Santa Cruz Island: May 12–15, 1929, *L. Ellison* (UC); vicinity of Prisoner's Harbor, April 26, 1930, *L. R. Abrams and I. L. Wiggins 129* (P, UC). Anacapa Island: May 12–15, 1929, *L. Ellison* (UCLA). Catalina Island: Bird Rock, January 22, 1920, *C. F. Millspaugh 4630* (UC); March 27, 1911, *I. J. Condit* (UC). San Nicolas Island: March 13, 1932, *J. T. Howell 8220* (P). San Miguel Island: April 10, 1930, *P. A. Munz and J. Voss 11877* (P). A specimen from Del Monte, Monterey County (May 24, 1923, *Eric Walther*, CA) is probably an escape from cultivation.

#### DISCUSSION

SECTION PUGIOPAPPUS. Although there is a close degree of relationship among the three species of this section, specific characters are abundant and obvious, and intergradation is quite lacking, despite the fact that *C. Bigelovii* and *C. calliopsidea* occupy a common geographic territory.

*Coreopsis Bigelovii* and *C. hamiltonii* agree in such characters as scapose stems, basally clustered leaves, and cylindric, truncate involucre with a variable number of linear outer bracts. *Coreopsis calliopsidea* stands quite apart with stems leafy, lower leaves obviously clustered, and campanulate involucre with five ovate outer bracts. When achenes are considered, however, the relationships are reversed. In *C. Bigelovii* and *C. calliopsidea* the pappus paleae are lanceolate acuminate and the disc achenes have permanently attached receptacular bracts with calloused midribs (more obvious in *C. calliopsidea*). The pappus paleae of *C. hamiltonii* are obovate with triangular-acute apices and the receptacular bracts, which lack the calloused midrib, fall separately from the disc achenes. All three species contrast in size of pappus palea, and in distribution and length of cilia on the disc achenes (pl. XXXII, figs. 1–17). A striking feature of *C.*

*hamiltonii*, not shared by *C. Bigelovii* or *C. calliopsidea*, or, indeed, by any of the Californian species of *Coreopsis*, is the strongly reflexed ligules. The ligules are usually horizontal in the subgenus *Leptosyne*.

When all of the features of similarity and difference between the three species of the section *Pugiopappus* are considered, *C. Bigelovii* is seen to occupy a position between *C. calliopsidea* on one hand and *C. hamiltonii* on the other. Phylogenetically *C. Bigelovii*, or an ancestral type from which it was derived, would appear to be primitive for this particular unit, *C. calliopsidea* and *C. hamiltonii* having diverged from it in opposite directions.

**SECTION EULEPTOSYNE.** There is much similarity in habit between the three species of this section, but a closer relationship is indicated between *C. californica* and *C. Douglasii*. In these two species the stems are always scapose, and the leaves basally clustered, while in *C. Stillmanii* there may be great variation in these characters. *Coreopsis Stillmanii* may even equal *C. calliopsidea* of the section *Pugiopappus* in leafiness and branching of the stems. *Coreopsis californica* and *C. Douglasii* agree, also, in their fleshy, linear, entire or once pinnate leaves, while *C. Stillmanii* has distinctive, flat, spatulate, once or twice pinnate leaves. Less obvious but no less characteristic leaf differences occur, however, between *C. californica* and *C. Douglasii*, for *C. californica* has the leaves erect, linear filiform, terete, and light green, while in *C. Douglasii* they are spreading (becoming erect with age), linear, flattened, and somewhat glaucous. As has already been mentioned, the leaf distinctions of *C. Douglasii* can be observed with certainty only in young living plants.

The general nature of the barrel shaped involucre is common to all three species, but in *C. californica* and *C. Douglasii* the outer bracts are fleshy, narrowly lanceolate, and gibbous at the base, while in *C. Stillmanii* they are flat, linear to spatulate, and merely angled at the base. Sherff relied in part on an extreme variation in the number of outer involucre bracts for the establishment of *C. Stillmanii* var. *Jonesii*. The number of these bracts, however, is inconstant in all the annual Californian species except *C. calliopsidea*, and this character does not seem to be of taxonomic significance.

#### EXPLANATION OF THE FIGURES

PLATE XXXII. Fig. 1. Head of *C. Stillmanii*,  $\times 1.5$ . Fig. 2. Inner face of achene of *C. Stillmanii*,  $\times 5$ . Fig. 3. Head of *C. californica*,  $\times 1.5$ . Fig. 4. Inner face of achene of *C. californica*,  $\times 5$ . Fig. 5. Head of *C. Douglasii*,  $\times 1.5$ . Fig. 6. Inner face of achene of *C. Douglasii*,  $\times 5$ . Fig. 7. Hair from achene of *C. californica*,  $\times 175$ . Fig. 8. Head of *C. Bigelovii*,  $\times 1.5$ . Fig. 9. Inner face of disc achene of *C. Bigelovii*,  $\times 5$ . Fig. 10. Inner face of ray achene of *C. Bigelovii*,  $\times 5$ . Fig. 11. Hair from disc achene of *C. Bigelovii*,  $\times 35$ . Fig. 12. Inner face of ray achene of *C. hamiltonii*,  $\times 5$ . Fig. 13. Inner face of disc achene of *C. hamiltonii*,  $\times 5$ . Fig. 14. Head of *C. hamiltonii*,  $\times 1.5$ . Fig. 15. Head of *C. calliopsidea*,  $\times 1.5$ . Fig. 16. Inner face of ray achene of *C. calliopsidea*,  $\times 5$ . Fig. 17. Inner face of disc achene of *C. calliopsidea*,  $\times 5$ .



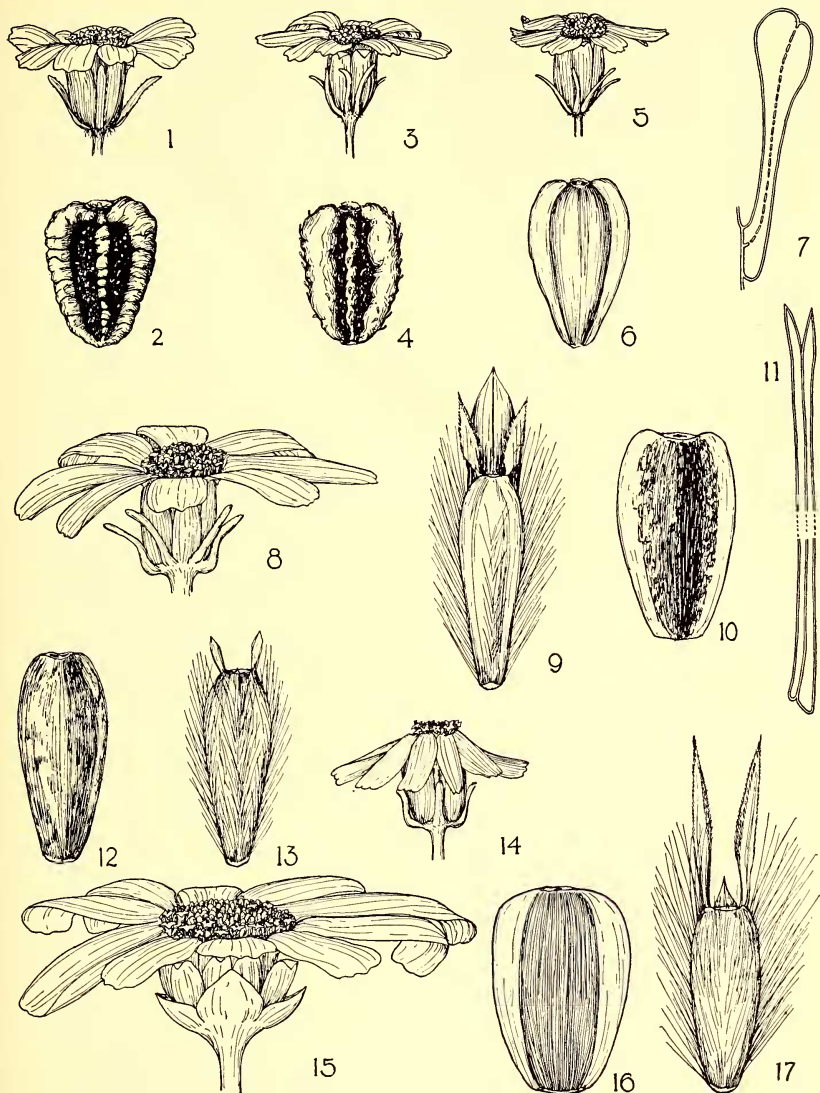


PLATE XXXII. NATIVE ANNUAL CALIFORNIAN SPECIES OF COREOPSIS.

(See explanation of figures on page 228.)

*Coreopsis californica* and *C. Douglasii* have the annulus of the disc corollas obviously bearded, while in *C. Stillmanii* it is characteristically glabrate. *Coreopsis Stillmanii* is the only annual California species of *Coreopsis* which lacks a distinctly bearded annulus.

Achenal differences play an important part in species differentiation within the section *Euleptosyne* as well as in the section *Pugiopappus*. One feature is sufficient to distinguish the achenes of *C. californica*, the presence of conspicuous, two-celled, clavellate or capitate hairs on body and wing. Even in immature achenes, with adequate magnification, these minuscule clubs or stalked knobs stand out clearly along the margin of the wing. Other characters which aid in distinguishing the achenes of *C. californica* are the dull, rough, tan to reddish surface, and the irregularly thickened, corky wing and central ridge of the mature and fertile achenes. *C. Douglasii* is marked by the glabrous nature of the immature achenes, and the smooth, shining, usually glabrous, brown body and thin, yellow or stramineous wing of the mature achenes. Even though the inner face occasionally bears some callous papillae or two-celled hairs, the hairs are smaller and scarcely clavellate or capitate, and almost never (one or two at most) occur on the wing. The sparsely hairy, smooth, central sterile achenes of *C. californica*, often with conspicuous red spots ("oil glands"), are quite different from the achenes of *C. Douglasii*, and are easily distinguished.

The question of specific relationships within this section is somewhat difficult to visualize. The specific delimitation of *C. Stillmanii* is obvious, even though this species transgresses the separate geographic ranges of both *C. californica* and *C. Douglasii*. Less obvious, however, is the specific differentiation of *C. californica* and *C. Douglasii*. With the use of herbarium specimens alone, there is but a single, clear basis for their separation, that of the achenes, a reliable criterion even when the achenes are immature. Only in young, living plants are the other differentiating characters adequately seen. A study of simultaneous garden cultures of *C. californica* and *C. Douglasii*, as well as field observations, gave convincing evidence that additional differences exist which justify a specific segregation. Another factor of significance is that the two species occupy distinct geographic territories. The western limit of *C. californica* is in very close approximation to the southern limit of *C. Douglasii*, but, unless the Pasadena locality of Jones' specimens should ever be validated, no specimens are on record which show an overlapping between the ranges of the two species.

One experiment was performed, which though yielding insufficient evidence to be significant in itself, may point the way to a convincing proof of the relationship of *C. californica* and *C. Douglasii*. A reciprocal cross was made between these two species

by removing the unopened, perfect disc florets from a young head of each, and leaving only the pistillate ray florets. The heads were then cross pollinated. A control was similarly treated and self pollinated. The heads were protected from insects and allowed to mature. Fully developed and apparently fertile ray achenes were obtained from the control, but only imperfect and partially developed ray achenes were obtained from the reciprocal cross.

*Coreopsis californica* predominates in the area which may be considered the center of diversity for the subgenus *Leptosyne* in California, cismontane and desert southern California. Considering this fact as well as its wider range and greater abundance, *C. californica* may be thought of as a unit ancestral to *C. Douglasii*. Whether *C. californica* or *C. Stillmanii* should be considered as primitive in the section *Euleptosyne* is questionable. On the basis of distribution, *C. californica* may rank as the most primitive member of the section, but the center of diversity may differ from the center of origin which often proves of greater significance in establishing relationships. The occasional occurrence of one or two smooth, straight awns upon the cupule of *C. Stillmanii* may indicate that this species is primitive in the section.

SECTION TUCKERMANNIA. In their perennial habit and maritime habitat, the two members of this section are highly distinctive among the Californian species of *Coreopsis*. They differ particularly in the arrangement and number of the heads, those of *C. gigantea* being numerous and cymosely clustered on short, leafy peduncles, those of *C. maritima* being few in number on long, essentially naked peduncles.

University of California,  
Berkeley, July 6, 1937.

## COLOR VARIATION IN DELPHINIUM CARDINALE HOOK.

CHARLES O. BLODGETT AND G. L. MEHLQUIST

Conspicuous variation in flower color within a species in its natural habitat is of some scientific interest. We wish, therefore, to record an observation which to the best of our knowledge has not heretofore been reported.

About four miles southeast of Lompoc, in the northwestern part of Santa Barbara County, California, there exists an extensive natural colony of *Delphinium cardinale* Hook. Through the kindness of Mr. Ian Sinclair of Bodgers Seed Company we were privileged to see this colony on July 17, 1937. The field of approximately eighty acres was on the north slope of a rather steep, thin-soiled hill, covered with loose calcareous rock from low cliffs above. The hillside bore a sparse cover of typical Coast Range chaparral, the shrubs ranging from two to five feet tall. Scattered among these were many plants of the brilliant